PHYTOTOXICOLOGY SECTION INVESTIGATION IN THE VICINITY OF INTERNATIONAL MALLEABLE IRON COMPANY (IMICO) GUELPH, ONTARIO ON APRIL 19, 1990

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INTERNATIONAL MALLEABLE IRON COMPANY (IMICO)

GUELPH, ONTARIO

ON APRIL 19, 1990

Report prepared by:

Phytotoxicology Section
Air Resources Branch
Ontario Ministry of the Environment

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Background

International Malleable Iron Company Limited operated this foundry on Beverly Street in Guelph since 1912. The foundry site is just under six hectares in size, the bulk of which is occupied by buildings, paved surfaces, and parking areas. From conversations with long time residents and workers, it appears that the foundry has produced a wide range of products over the years and utilized an equally wide range materials, including tanks and artillery after both world wars. In August of 1989, Proctor and Redfern consultants produced a report on the property for IMICO which outlined their environmental investigations on the property. The report concluded that there were elevated levels of cadmium, chromium, molybdenum and zinc on site, as well as pointing out the necessity of registering the PCB storage site. Due to surface and subsurface drainage characteristics the report expressed the possibility of off-site contamination existing, largely through groundwater. It also pointed out that liability rested with the site owner on the basis of existing legislation.

In September of 1989, IMICO laid off any remaining workers (apparently, most had been laid off earlier) and abandoned the property. All officers and directors resigned and there is no one to act for the company. The Bank of Montreal, a creditor holding security on the assets, refuses to take possession of the property.

Local residents are concerned that contamination may extend off site. District Office staff conducted some preliminary soil sampling in January, 1990 in order to partially address the concerns expressed by residents and the media.

On April 19, 1990, at the request of the West Central Region office, Marius Marsh of Phytotoxicology Section conducted an investigation to determine the degree and extent of off-site surface soil contamination in the vicinity of the IMICO property. The following is a report on that investigation. It is noted that this report does not address possible contamination of subsurface soils or of groundwater, nor does it consider organic contaminants.

2 Methods

Surface (0-5 cm) soil samples were collected in duplicate from 12 sites in the vicinity of the foundry as well as from three control locations more removed from the foundry (see Figure 1 and Appendix 3). Samples were also taken in duplicate from the 5-15 cm depth at two locations.

All samples were collected using standard Phytotoxicology sampling techniques (O.M.E., 1983). Samples were delivered to the Phytotoxicology Section sample processing laboratory in Toronto where they were dried and ground before being submitted to the Laboratory Services Branch Trace Inorganics Laboratory for chemical analysis.

3 Results

The results of the chemical analyses of the samples are presented in Table 1. In order to assist in the interpretation and understanding of the spacial distribution of these elements, concentrations of some of the elements were plotted using a contour mapping program (Surfer,

Table 1. Mean[1] Elemental concentrations (ug/g) in the surface soil (0-5cm) in the vicinity of the IMICO foundry, Guelph. April 19, 1990.

	Site								
Element	1	2	3	4	5	6	7	8	9
Copper	38	30	36	34	42	59	32	69	24
Nickel	14	9.6	10	9.0	11	9.2	7.8	12	12
Lead	160	110	140	140	240	160	120	120	160
Zinc	580	400	1700	660	820	310	1000	1000	460
Iron	24000	18000	14000	14000	14000	18000	18000	14000	20000
Manganese	1100	700	460	360	320	620	360	370	760
Aluminum	16000	12000	9800	9400	10000	12000	8600	9300	13000
Arsenic	9.7	8.2	8.0	10	6.4	7.7	5.7	8.3	6.2
Barium	66	69	70	74	80	70	50	79	73
Cadmium	1.1	1.0	3.6	1.7	1.3	0.96	1.8	6.0	0.98
Chloride	<0.5	6.2	5.3	4.5	8.2	12	5.8	7.4	12
Chromium	16	14	14	14	14	18	10	14	14
Fluoride	60	59	100	140	160	260	92	97	84
Mercury	.075	0.095	0.095	0.095	0.20	0.12	0.09	0.16	0.09
Sodium	100	100	135	180	170	220	120	140	140
Antimony	0.72	1.5	1.2	1.5	3.0	1.6	1.3	1.2	2.2
Selenium	0.7	1.4	1.9	1.9	1.6	0.62	1.4	4.6	0.95
Strontium	21	52	73	78	81	34	44	72	34
Sulphur (%)	0.042	0.09	0.12	0.071	0.099	0.053	0.094	0.18	0.058
Vanadium	44	34	26	26	26	34	27	30	36
Cobalt	10	9.8	9.2	8.1	8.3	8.4	7.0	7.9	8.9
Molybdenum	0.9	0.8	1.6	0.4	0.4	1.6	0.2	BD	BD
Beryllium	0.82	0.65	0.61	0.62	0.52	0.54	BD	BD	0.63

	Site								
Element	9*	10	11	12	13	13*	14	15	ULN**
Copper	28	40	87	54	38	34	35	40	100
Nickel	10	11	19	16	12	11	12	12	60
Lead	110	200	420	300	280	240	200	160	500
Zinc	320	560	1100	1100	550	520	560	940	500
Iron	18000	23000	27000	27000	22000	19000	20000	22000	35000
Manganese	590	680	1200	1100	650	610	720	980	700
Aluminum	12000	12000	16000	18000	12000	12000	12000	14000	-
Arsenic	5.0	8.2	37	13	6.2	6.2	7.0	6.7	20
Barium	66	92	200	99	92	84	74	80	-
Cadmium	0.81	1.1	2.8	2.0	1.3	1.0	1.1	1.8	4
Chloride	6.1	8.2	8.1	5.3	14	10.2	12	9.2	-
Chromium	12	16	30	20	16	14	14	20	50
Fluoride	88	120	100	68	100	100	100	100	-
Mercury	0.11	0.18	0.26	0.12	0.11	0.10	0.14	0.14	0.5
Sodium	160	140	160	140	200	160	140	140	-
Antimony	1.5	4.7	7.3	7.2	7.4	8.0	5.6	1.6	8
Selenium	0.78	1.8	2.4	1.4	0.72	0.85	0.92	0.76	2
Strontium	40	36	51	32	38	38	38	28	-
Sulphur	0.042	0.075	0.066	0.07	0.062	0.057	0.056	0.052	-
Vanadium	33	35	43	46	38	34	35	39	70
Cobalt	9.2	9.0	12	12	9.5	9.9	10.8	10.5	25
Molybdenum	0.43	BD	0.41	0.8	0.7	0.4	0.5	0.4	3
Beryllium	0.56	0.60	0.83	0.83	0.56	0.60	0.61	0.73	-

[1] Average of duplicate samples

* 5 - 15cm depth

** ULN - Upper Limit of Normal - see Appendix for explanation

BD - Below detection limit

ver. 3.0). These contour maps, which are shown in Figures 2-11, give an indication of a likely pattern of distribution of the specific contaminant; however, they should be interpreted with care since accuracy is known only at the 15 sampling stations. (Settings used in "Surfer" were as follows: Kriging using normal search method on the 10 nearest points. Grid size of 25 x 25. Smoothing with tension factor of 2.)

4 Discussion

An examination of Table 1 reveals that, with the exceptions of zinc and manganese, ULN's for the elements tested are exceeded only at Sites 8 for cadmium and selenium and site 11 for arsenic and selenium. Since arsenic concentrations are higher than local background levels at Site 12, the contour map for arsenic indicates a zone of elevated arsenic concentrations just northeast (downwind of prevailing winds) of the IMICO factory (see Figure 2), and implicates IMICO or other factories adjacent to IMICO as possible sources.

Manganese concentrations were also above the ULN at sites 11 and 12; however, one of the three control sites as well as sites 9, 14, and 15 displayed high manganese concentrations, hence there may be local anomalies with respect to this metal which may be of as much significance as the IMICO foundry. The lack of a clear pattern for manganese on the contour map (Figure 3) shows that the observed high concentrations downwind cannot be solely attributed to the foundry. Also, the high concentrations of cadmium and selenium at Site 8 are not matched at stations to the northeast, and hence are unlikely to be a result of emissions from the foundry. They are more likely to have resulted from a very localized source, such as storage of materials in the past. Although the area is now an empty field, residents nearby informed me that it had once been used to hold materials, such as military equipment, prior to smelting.

Although other elemental concentrations do not exceed the ULN's, the contour maps indicate accumulations of antimony, barium, copper, chromium, lead, and mercury, downwind from the foundry, with Site 11 being the site primarily affected (see Figures 4 - 9). The maps indicate the main area affected to be limited in extent.

Zinc is another element for which the distribution is anomalous (see Figure 10). Zinc concentrations exceed the ULN of 500 ug/g at 12 of the 15 sites, including at two of the control sites. Average zinc concentrations at the Guelph Reformatory site (Site 3) were 1700 ug/g. Since previous sampling by the District Office indicated very high zinc at a site on the reformatory grounds about 200m west of Site 3, these values must be regarded as being real, and cannot be attributed to sampling or analytical error. High zinc concentrations encountered in this survey cannot, therefore, be attributed to IMICO.

Although a consultants report concerning conditions on the IMICO site found areas with high molybdenum levels, the current survey did not find evidence of molybdenum contamination in soils off the site.

Fluoride concentrations in the surface soil exhibit a pronounced increase in the area of the foundry. The pattern indicated by the contour map (Figure 11) implies a source to the immediate southwest of IMICO. A factory which produces foundry sand is located across Stevenson St. from IMICO and is a possible source of fluoride.

In view of the ultimate necessity for decommissioning of this site, it should be noted that residential decommissioning guidelines of 25 ug/g for arsenic and 2 ug/g for selenium (O.M.E., 1989b) are exceeded at Site 11 and that the concentrations in this location appear to be a result of emissions at or immediately adjacent to the IMICO foundry. A property by property survey along Simcoe St. and on other properties immediately east and northeast of the factory would be required to delineate the full extent of contamination in a detailed manner appropriate for cleanup activities. The guideline exceedances at Site 8 for cadmium (decommissioning guideline of 4 ug/g) and selenium cannot be as readily attributed to IMICO emissions, and the zinc concentrations in excess of the decommissioning guideline (800 ug/g) would appear to result from factors other than the foundry.

Figure 1: Station Locations for Soil Sampling, IMICO, Guelph, April 19, 1990.

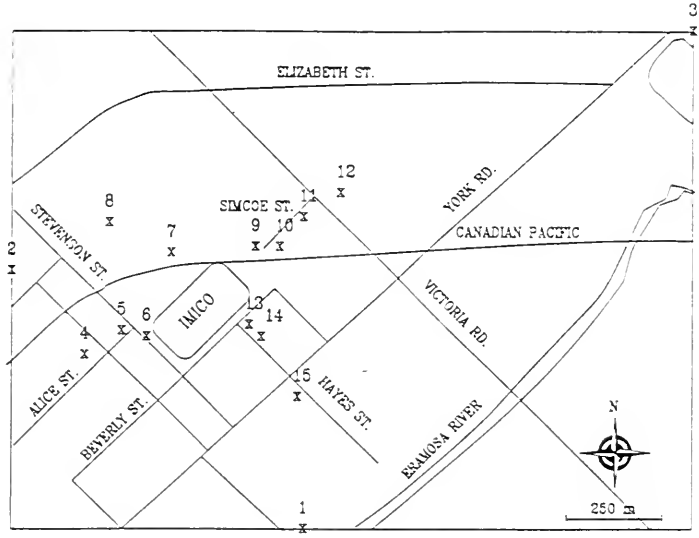


Figure 2: Contour Map of Surface Soil Arsenic Concentrations (ug/g). IMICO, Guelph, April 19, 1990.

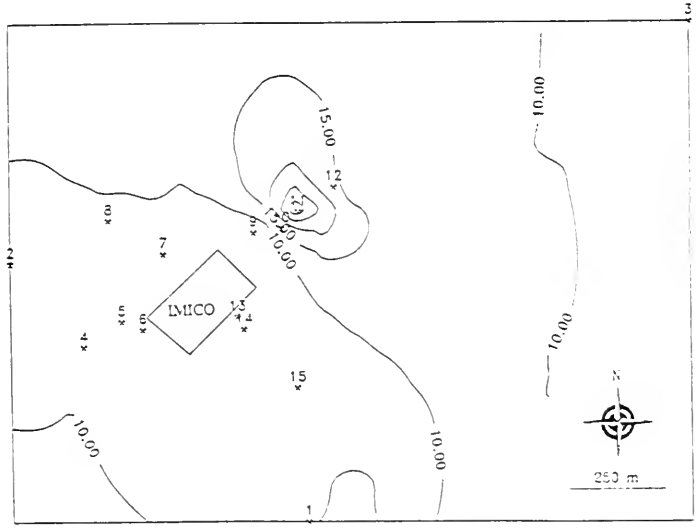


Figure 3: Contour Map of Surface Soil Manganese Concentrations (ug/g). IMICO, Guelph, April 19, 1990.

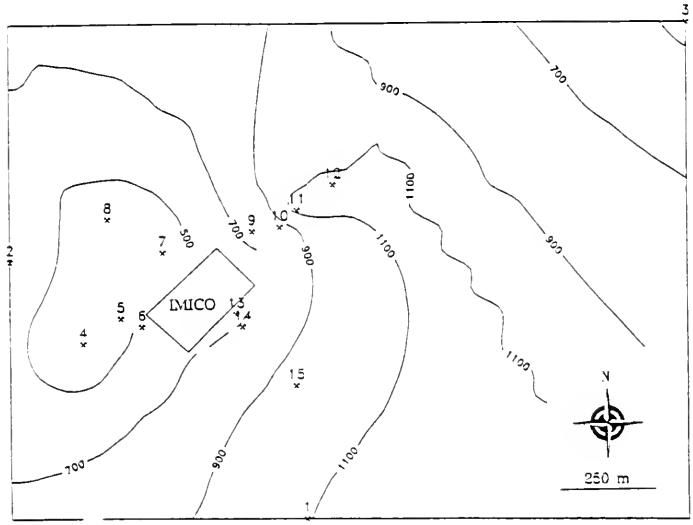


Figure 4: Contour Map of Surface Soil Antimony Concentrations (ug/g). IMICO, Guelph, April 19, 1990.

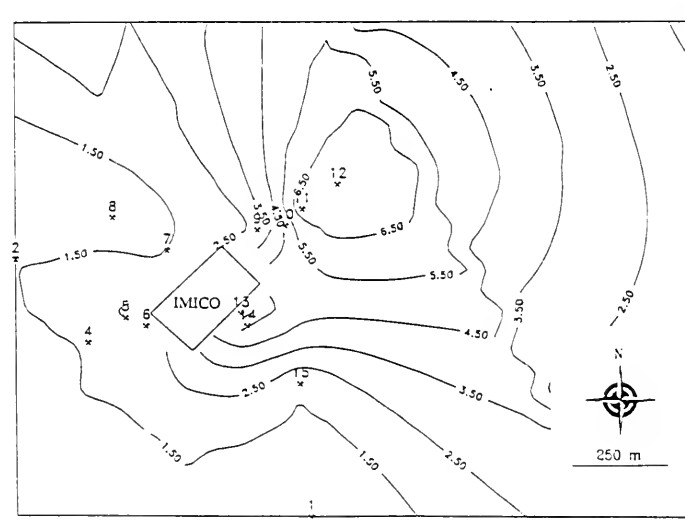


Figure 5: Contour Map of Surface Soil Barium Concentrations (ug/g). IMICO, Guelph, April 19, 1990.

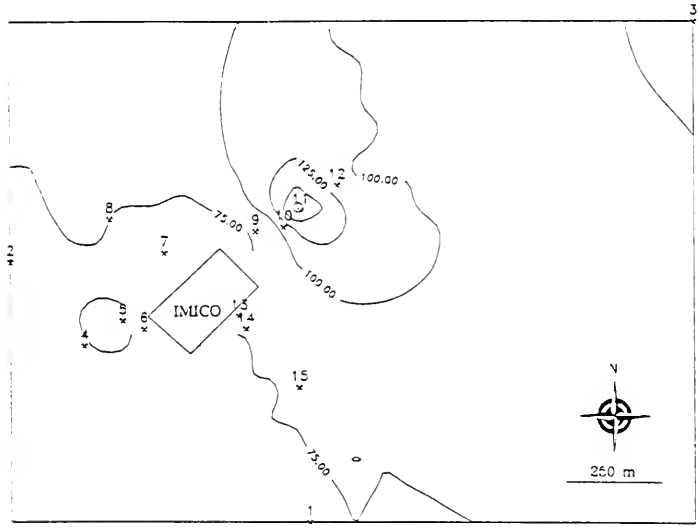


Figure 6: Contour Map of Surface Soil Copper Concentrations (ug/g). IMICO, Guelph, April 19, 1990.

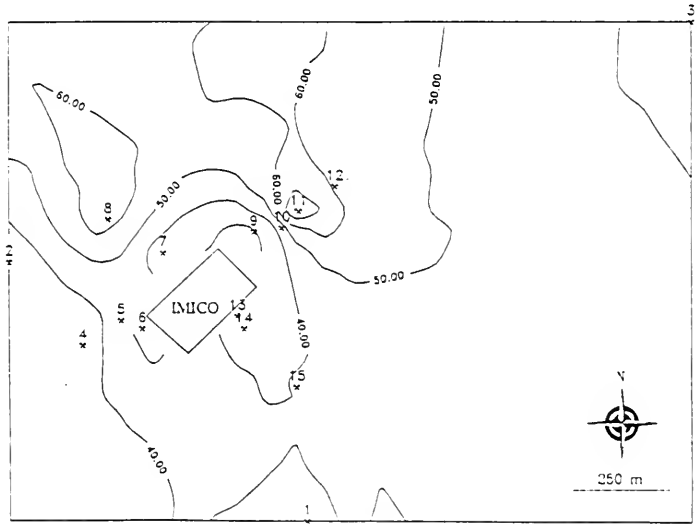


Figure 7: Contour Map of Surface Soil Chromium Concentrations (ug/g). IMICO, Guelph, April 19, 1990.

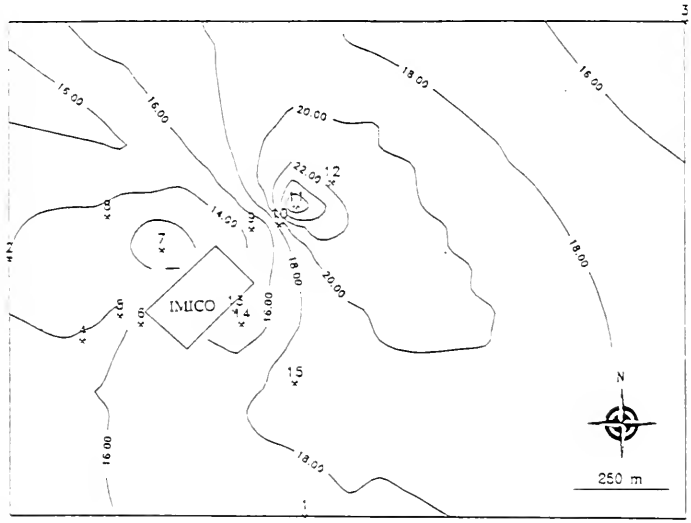


Figure 8: Contour Map of Surface Soil Lead Concentrations (ug/g). IMICO, Guelph, April 19, 1990.

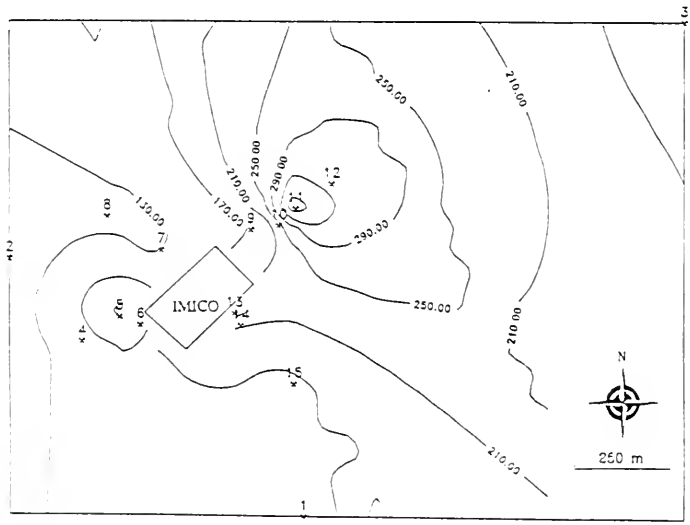


Figure 9: Contour Map of Surface Soil Mercury Concentrations (ug/g). IMICO, Guelph, April 19, 1990.

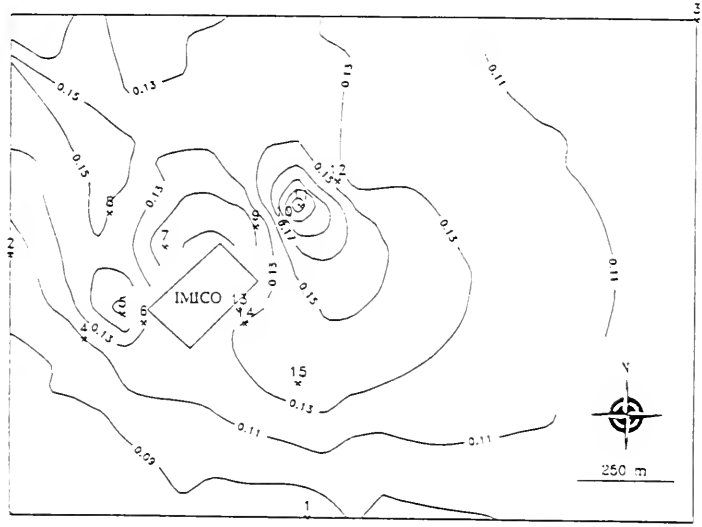


Figure 10: Contour Map of Surface Soil Zinc Concentrations (ug/g). IMICO, Guelph, April 19, 1990.

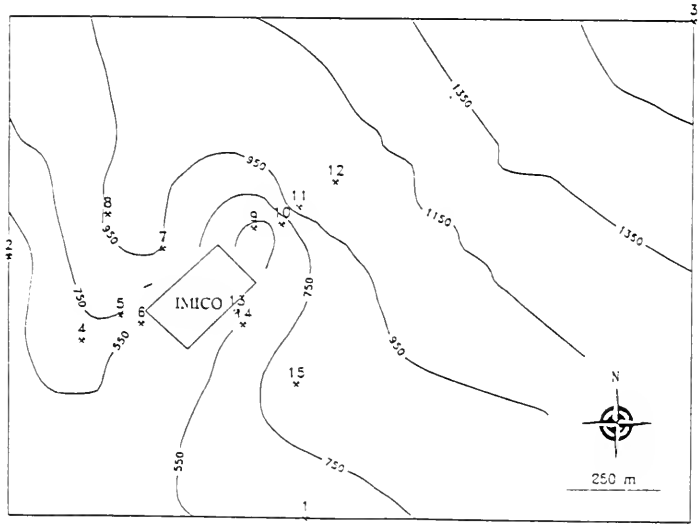
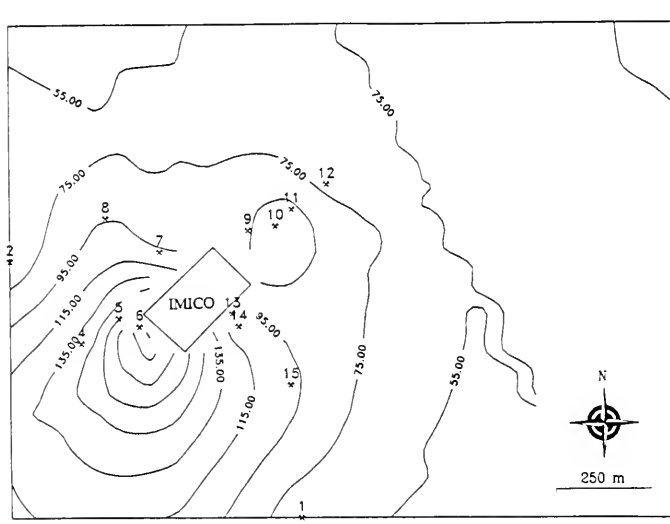


Figure 11: Contour Map of Surface Soil Fluoride Concentrations (ug/g). IMICO, Guelph, April 19, 1990.



5 Appendices

5.1 Explanation of OME "Upper Limits of Normal" Contaminant Guidelines

Interpretation of concentrations were made based on "Upper Limit of Normal" (ULN) guidelines established by the Phytotoxicology Section, Air Resources Branch (OME, 1989). The ULN was determined by examining an extensive database for soils and vegetation samples collected at sites removed from any point source of contamination. Statistical tests were applied to the data to calculate the ULN value. This ULN value would not normally be exceeded in 99 samples in 100 for background areas. Values which exceed the ULN are considered likely to have resulted from contamination. Values which exceed the ULN do not necessarily imply that the element is toxic at that level. Concentrations which are below the guidelines are not known to be toxic.

It is stressed that the ULNs do not represent maximum desirable or allowable levels of contaminants, but rather serve as guidelines which, if exceeded, flag situations requiring further investigation to determine the significance of the above normal concentrations. Comparisons of sample elemental concentrations with those from control or reference areas may also serve to flag such situations at contaminant concentrations lower than the ULNs.

5.2 References

Ontario Ministry of the Environment, 1983. Field Investigation Manual. Phytotoxicology Section, Air Resources Branch; Technical Support Sections - NE and NW Regions.

Ontario Ministry of the Environment, 1989. Ontario Ministry of the Environment "Upper Limit of Normal" Contaminant Guidelines for Phytotoxicology Samples. Phytotoxicology Section - Air Resources Branch, ARB-138-88-Phyto. ISBN 0-7729-5143-8

Ontario Ministry of the Environment, 1989b. Guidelines for the Decommissioning and Cleanup of Sites in Ontario. Waste Management Branch. Feb. 1989.

5.3 Station Locations

1) About 30 m NE of turn-around at S end of Armstrong Ave.

2) Western corner of Mico Valleriotte Park

3) Guelph Correctional Institute grounds. Between trees at NE corner of lake.

4) 204A Alice St. - backyard.

5) 212 Alice St. - East sideyard.

6) Stevenson St. - on east blvd S. of Alice St. (between hydro poles).

7) Field NW of IMICO. - on E side just N of railway tracks.

8) Field NW of IMICO - at N end just W of ditch and immediately S. of houses.

9) 6 Simcoe St. - West sideyard.

10) 5 Simcoe St. - backyard.

11) 15 Simcoe St. - backyard on east side.

12) 142 Victoria Rd. S. - backyard on north side.

13) 201 - 302 Beverly St. - front blvd.

14) 201 Beverly St. - backyard.

15) 407 York Rd. - S. of driveway